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Online Social Networks, Social Capital and Health-related Behaviors: A State-of-the-art Analysis

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Abstract:

The percentage of obese individuals in the population has increased exponentially over the last decade, making obesity a phenomenon of significant global concern. Individual behaviors, preferences and lifestyle choices are subject to social and environmental influences and social networks have been identified as a key contributor to the global obesity epidemic. Numerous empirical studies have found a relationship between dimensions of social capital, well-being and population health. It is the thesis of this article that social capital in online social networks might be similarly associated. Addressing previously identified gaps in the literature, our conceptual model enables the analysis of the relationships between the structure and content of an individual's online social network, the resulting opportunities and limitations to accessing resources and his or her health-related behaviors and body weight is introduced. Moreover, the model incorporates potential social capital as a special type of social capital in online social networks and uses network-based measures instead of self-reported data. Additionally, literature-based hypotheses discussing the relationships between the constructs of the model are presented. Establishing profound theoretical groundwork, this article encourages future research crossing the boundaries between information systems, health informatics and sociology. This study concludes by proposing a new Facebook e-health application to collect longitudinal data using the aforementioned conceptual model in order to explore the presented ideas further.

Keywords: conceptual model, social capital, online social networks, social determinants of health, social network analysis

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Communications of the Association for Information Systems

I. INTRODUCTION

"People are connected, so their health is connected." This statement, by Smith and Christakis [2008], serves to summarize in one sentence a central theme in this article.

Overweight and obesity have become an issue of global concern. In 1995, 200 million adults worldwide were obese and another eighteen million under-five children were classified as overweight [WHO, 2012b]. By 2008, the number of overweight adults reached 1.5 billion, with 200 million men and nearly 300 million women of these being obese. This rapidly increasing prevalence of obesity is a phenomenon often referred to as the "obesity epidemic" [WHO, 2000]. Christakis and Fowler [2007] who conducted a thirty-two-year longitudinal study suggest a person-to-person spread of obesity similar to the transmission of an infectious disease. Supporting their study, Gershenson [2011] notes that the spread of ideas and behaviors, as well as contagious trends and habits within social networks, may provide a powerful substitute for physical mechanisms to spread diseases and result in a so-called "social infection." Yet social networks themselves are value-neutral and, hence, may just as well offer a means to stop the propagation of non-communicable diseases in the same ways that they facilitate their spread [Gershenson, 2011]. For instance, weight management interventions, including network-driven strategies, may be an effective means to reinforce weight-loss progress [Bahr, Browning, Wyatt and Hill, 2009].

McNeill, Kreuter and Subramanian [2006] identified social networks as one of the most important dimensions of people's social environment that may enable or constrain the adoption of health-promoting behaviors. Additionally, living and working conditions, as well as broader social, economic and cultural circumstances, serve to shape the social network in which an individual is embedded [Dahlgren and Whitehead, 2007].

Social media have become part of many people's everyday life and are suggested to influence the diffusion and adoption of health-related behaviors [BVDW, 2010; Ma, Chen and Xiao, 2010].

Taking into account the growing importance of online social networks, this article investigates the role of online social networks in the context of overweight and obesity and proposes starting points for the usage of online social networks to foster healthier lifestyles in the future.

II. BACKGROUND

Worldwide obesity has more than doubled since the 1980s. Formerly considered a high-income-country problem, today, obesity is increasingly linked to urban settings in low and middle-income countries [WHO, 2011a]. Moreover, obesity leads to serious health consequences [Pi-Sunyer, 2002] and is associated with more deaths worldwide than deaths in underweight populations [WHO, 2011b]. The future looks even more bleak, given that approximately 43 million children under the age of five in 2010 have been diagnosed as medically overweight, which indicates that the projections are likely to be even higher for obese adults within the next years [WHO, 2011a]. According to the WHO [2012a], obesity is particularly problematic in North America, Egypt and Saudi Arabia.

In and of themselves, these numbers of obese populations are alarming indeed, but, when considered in conjunction with the fact that obesity also is a direct risk factor for a much greater likelihood of various complex and unpleasant secondary disorders such as diabetes, heart diseases and cancer [MedStar Physician Partners/MedStar Family, 2007], it is evident that the far-reaching impact of obesity is not only on individual health outcomes but also on the economic impact to healthcare delivery for countries. Yach, Stuckler and Brownell [2006] distinguish between the macroeconomic and microeconomic burden of obesity and associated secondary disorders: The first refers to the direct costs in the form of medical and treatment costs leading to increased healthcare expenses: For example, in the U.S., the medical costs of obesity were estimated in 2008 to be as high as $147 billion per year. This number is equal to about 9 percent of all medical spending [Finkelstein, Trogdon, Cohen and Dietz, 2009]. By 2030, costs attributable to overweight and obesity are projected to account for 16–18 percent of total U.S. healthcare costs [Wang, Beydoun, Liang, Caballero and Kumanyika, 2008]. On the other hand, the microeconomic burden accrues in the form of indirect costs to society by impacting such areas as decreased returns on education, lower earnings and incomes, a higher rate of premature retirement and unemployment and, therefore, higher dependence on public welfare [Yach et al., 2006].

The causes of overweight and obese populations are multifaceted and result from the co-occurrence and interaction of several factors, including individual medical conditions and behaviors, social determinants and socioeconomic factors [James, Leach, Kalamara and Shayeghi, 2001]. While it is true that individual medical conditions, such as genetics, may determine a person's susceptibility to gain weight, the dramatic increase in the number of obese people worldwide cannot be explained by medical conditions alone [WHO, 2000]. Other factors, such as individual behaviors that include dietary and physical activity patterns, determine the energy imbalance of individuals, which in turn can lead to obesity [WHO, 2011a]. The World Health Organization [WHO, 2011a] identifies an energy imbalance between consumed and expended calories as the fundamental cause of obesity. Generally, over the past decades an increased consumption of energy-dense foods that are high in fat, sugar and salt can be observed. Contemporaneously, however, people engage less and less in physical activity, especially as many forms of work and relaxation activities are now more sedentary [Yach et al., 2006]. Thus, it appears that individual behaviors and lifestyle choices shaped by the social environment drive and significantly impact the global obesity epidemic [WHO, 2011a; Huffman, 2011]. Individual behaviors, in particular, health-related behaviors, such as physical activity, diet, sleep, smoking, alcohol consumption, as well as adherence to medical treatments and help-seeking behavior [Berkman, Glass, Brissette and Seeman, 2000; Hyyppä, 2010], appear to be significant in this context. Hence, investigating the relationship between online social networks and an individual's body weight and health-related behaviors—including dietary and physical activity patterns—thus forms the focus in this research.

Previous studies have focused on the spread of obesity within traditional (offline) social networks (e.g., Christakis and Fowler, 2007; Cohen-Cole and Fletcher, 2008; Fowler and Christakis, 2008). However, the dramatic growth of electronic (online) social networks has resulted in blurring the boundaries between the real and the virtual world [BVDW, 2010].

Web 2.0 technologies are applied in various areas, such as education [Shim, Decleva and Guo, 2011], traveling, organizational knowledge management [McKeen and Smith, 2007] and job seeking [Parameswaran and Whinston, 2007; BVDW, 2010]. In the context of health care, such Web 2.0 or Health 2.0 applications combine health data and health information with (patient) experience through the use of information and communication technologies (ICT) [Bos, Marsh, Carroll, Gupta and Rees, 2008]. One example of a Health 2.0 application is the largest and best-known online social networking health site, PatientsLikeMe. Founded in 2004, the health online social network had more than 160,500 members as of August 2012 [PatientsLikeMe, 2012]. PatientsLikeMe (PLM) allows its members to find patients with similar symptoms, to share health data and to learn from others. Following a patient-driven healthcare approach, PLM facilitates disease self-management through better information and expertise sharing [Swan, 2009]. In academia, the data generated on the platform is used in many ways, including data mining for biomedical research [Nakamura, Bromberg, Bhargava, Wicks and Zeng-Treitler, 2012] and crowdsourced health research studies [Swan, 2012], for instance. Embracing patient-centered health-informatics and aspects of persuasive technologies, Health 2.0 applications are becoming recognized as an effective self-care information and disease self-management tool today [Mattila, Korhonen, Salminen, Ahtinen, Koskinen, Särelä, Pärkkä and Lappalainen, 2010]. There is clearly scope for persuasive technologies to encourage individuals to live healthy lifestyles with a focus on being physically active using mobile phone applications [Munson and Consolvo, 2012].

To date, social media have proved to be powerful in shaping opinions and behaviors and affecting different areas of public life [Wefing, 2012]. Recent examples include the 2009 "Twitter-revolution" in Iran, as well as the revolutions in Tunisia and Egypt at the beginning of 2011 in which social media was important in organizing the protest movement [von Rohr, 2011]. During the riots in England in August 2011, rioters communicated using social media applications to incite looting and violence [Schone, 2011]. On the other hand, Twitter and Facebook were used to spread information on the riots and to organize clean-up operations in the affected areas [Polke-Majewski, 2011].

Many people are connected to their friends via online social networks. Those online friends may—just as with "real world contacts"—shape people's opinions [Kaplan and Haenlein, 2010]; particularly, influential members are capable of maximizing the spread of information within social network sites [Bodendorf and Kaiser, 2009; Kaiser, Kröckel and Bodendorf, 2010].

Therefore, an influence on people's health-related behaviors through online contacts is suggested [Ma et al., 2010]. In a recent study of a health online social network, Ma et al. [2010] showed that the users' diet progress toward weight-change goals was positively correlated with the number of friends and their friends' weight-change performance. The authors state that online social connections may have a great influence on users' health-related behaviors and that the strength of social influence may even be greater than in real-world social networks.

Given that online social networks today are becoming more important in people's daily lives, it is reasonable to hypothesize that online social networks might also impact the adoption of health-related behaviors. Thus, this research focuses on the analysis of the relationship between people's online social connections, their health-related

behaviors and their body weight in order to create network-driven strategies to promote and reinforce positive norms and sound health-related behaviors.

III. LITERATURE REVIEW

This article aims to build a conceptual model to facilitate the use of online social networks to positively affect an individual's health status. Dealing with a specific and interdisciplinary topic [Wilson and Lankton, 2004] which—to the authors' best knowledge—has not been addressed in the existing literature, the conceptual model is constructed using concepts from several academic disciplines, including sociology, information systems, network research and social network analysis [Steiny, 2009].

Providing the theoretical background for this research, the following sections examine contributions dealing with the association between offline or online social networks, social capital and health (see Figure 1), as well as existing frameworks on social capital.

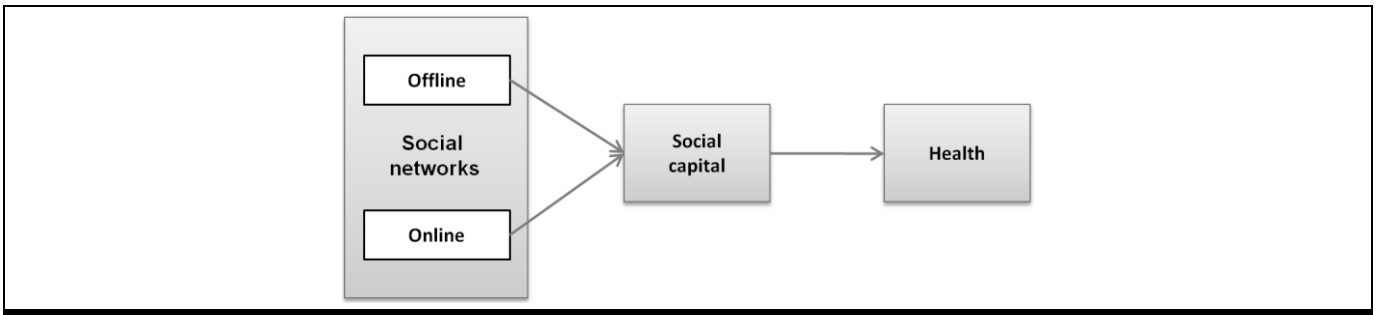

Figure 1. Association Between Offline or Online Social Networks, Social Capital and Health

Social Networks

A social network "consists of a finite set or sets of actors and the relation or relations defined on them" [Wasserman and Faust, 1994, p. 20]. Most commonly, social relationships are categorized according to strong and weak ties [Kneidinger, 2010]. Tie strength is determined by the amount of time, the emotional intensity, the intimacy and the reciprocal services that characterize the tie [Granovetter, 1973]. Hereby, intimacy is influenced by the degree of mutual confiding between individuals, the amount of emotional investment in the relationship and the importance of discussed matters [Granovetter, 1973; PRI, 2005].

According to Granovetter [1973] *strong ties* are intimate bonds between family members or close friends that are maintained regularly and permanently. Tending to be concentrated in particular groups, they are of an informal nature and occur between network members who have a shared social identity. In contrast, *weak ties* emerge as non-intimate bonds between acquaintances. Maintained infrequently and inconsistently, weak ties may be formal contacts and are more likely to link members of different small groups [Rostila, 2011].

With regard to online media, Bakshy, Rosenn, Marlow and Adamic [2012] found that weak ties play a more dominant role than strong ties in information diffusion. Haythornthwaite [2002] suggests *latent ties* as an additional type of tie which emerges when a new medium (for example, social network sites) is introduced. Those ties are technically possible communication channels that have not yet been activated and may help to develop and strengthen weak ties. Moreover, situational ties occur when individuals share common habits (for example, smoking) or are confronted with particular people in their daily life (such as neighbors, family, or workplace colleagues) [Slama, Chiang and Enarson, 2007]. When an individual feels close to people in the same situations, this is an indicator that trust has arisen form these social networks [Li, Pickles and Savage, 2005].

Social network sites are applications that allow users to build a semi-public or public profile within a bounded system, to create explicit linkages to other users and to communicate by sharing information or sending messages between each other. Organized around people, social network sites are structured as egocentric networks with the individual at the center of their personal network [Boyd and Ellison, 2007; Kaplan and Haenlein, 2010].

Social Capital

Rooted deeply in the social sciences, the concept of social capital has been addressed in the writings of leading authors in sociology, including Durkheim, Simmel, Marx and Weber [Hyyppä, 2010]. Social capital was (re)introduced by sociologists Bourdieu [1986] and Coleman [1988] in the 1980s. The subsequent work of the political scientist Robert D. Putnam and in particular his often-cited book *Bowling Alone,* in which Putnam [2001]

argues that the decline of social capital in the United States resulted in an increased interest in—and application of—social capital theory in other disciplines, such as the health-related sciences [Rostila 2011; Hyyppä 2010]. A great number of different social capital notions illustrate the conceptual disagreements and confusion on the concept. Some scholars consider social capital to be a collective and nonexclusive good attributed to social structures (e.g., Putnam, 2001; Putnam, Leonardi and Nanetti, 1994). However, in sociology, the concept is considered to be an individual-level resource and, thus, seen as a feature of individual actors within a social structure [Bourdieu, 1986; Lin, 2001b; Coleman, 1988; Rostila, 2010b]. Examining the relationship between individuals' online social connections, health-related behaviors and health status, this research is grounded in Lin's network-based notion of social capital. Lin defines social capital as *"resources* embedded in one's *social network*, resources that can be accessed or mobilized through *ties* in the network" [2001b, p. 29].

Patterns of relationships define the structure of social networks in which different types of resources and social capital are embedded. Commonly, social resources are classified into four categories [Rostila, 2011]:

- *Informational support* refers to information, knowledge and advice circulating in the network.
- *Emotional support* ensures that persons feel loved, admired and respected.
- *Instrumental support* describes help with tangible needs, such as money.
- *Appraisal support* refers to assistance with decision-making or giving feedback.

The preceding types of resources are provided by different kinds of relationships. Formal and weak social ties are more likely to generate informational support, whereas informal and strong social ties are associated with the provision of emotional support [Rostila, 2011].

With regard to the different forms of social capital, Putnam et al. [1994] differentiate between bonding and bridging social capital, as shown in Figure 2.

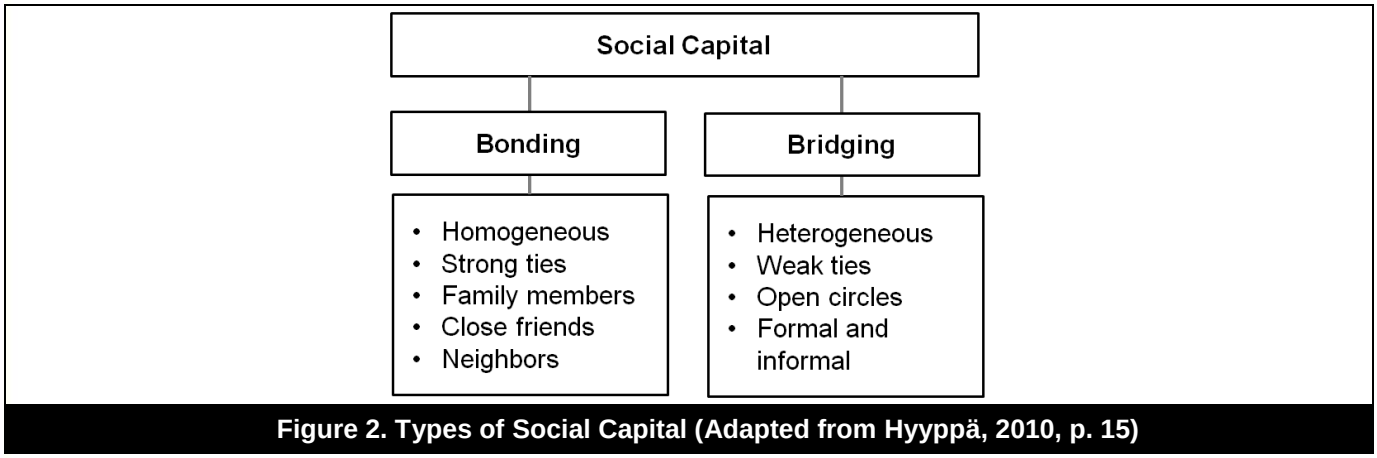

Figure 2. Types of Social Capital (Adapted from Hyyppä, 2010, p. 15)

Bonding social capital overlaps with the idea of strong ties. Being inward-looking, it is based on networks of people featuring a high degree of homogeneity, expressed in similar interests and characteristics and supports individuals in "getting by" in life [Stone and Hughes, 2002]. Bridging social capital, however, is outward-looking and based on networks with weak ties. It connects heterogeneous people across social groups and provides access to sets of non-redundant resources. It has been argued that weak social ties provide better opportunities for the achievement of informational and instrumental resources, for instance, job-related information, when helping individuals "get ahead." Yet not all bridging links are equally useful [Lin, 2001b]. In the case of job seeking, for instance, a weak tie contact may be particularly valuable if the contact person is in a more influential and powerful position than the job seeker [Avenarius, 2010].

In this article, we concentrate on the influence of online social networks on health-related behavior using the concept of social capital. The question of whether the Internet carries social capital is not a new one. Lin [2001b] suggested that the connections in the virtual world could lead to a rise of social capital due to the increased access to information for—at least theoretically—everyone. Further, people are enabled to connect with fewer time and space constraints.

Since Lin's statement in 2001, there has been a debate among scholars concerning how online interactions influence social capital. Summarizing the body of literature on the subject, Ellison, Lampe, Steinfield and Vitak [2010] identified three major directions:

1. Internet use allows people to generate new social capital, for example, by triggering interaction with previously unknown people.
2. Internet use decreases people's stock of social capital, for example, by detracting people from face-to-face interaction.
3. Internet use strengthens people's offline social network and supports the individual in maintaining existing relationships, for example, by enhancing traditional means of communication.

In the more recent literature, online social connections and particularly activities in social network sites, such as Facebook, are considered to have a positive impact on social capital [Antoci, Sabatini and Sodini, 2011; Ellison, Steinfield and Lampe, 2011; Young, 2011]. They play an important role facilitating people to keep in touch with the existing offline social network and are useful for the development of new ties, too. Yet, most online ties are based on some kind of previous offline connection [Ellison, Steinfield and Lampe, 2007; Antoci et al., 2011; Brandtzæg and Nov, 2010]. Social network sites are regarded as particularly advantageous in that they allow users to create and maintain large and diffuse networks in a convenient way and enable an easy way to communicate with friends in distant locations [Antoci et al., 2011]. As social capital does not require close friendship, even weak ties in social network sites are likely to have a positive impact on social capital [Ellison et al., 2010].

A number of studies, primarily conducted using the social network site Facebook, have sought to identify the association between social network site use and social capital [Brandtzæg and Nov, 2010; Burke, Kraut and Marlow, 2011; Ellison et al., 2007; Vitak, Ellison and Steinfield, 2011].

The above-stated advantages regarding social network sites have been suggested to have a specifically positive impact on the formation and enhancement of bridging social capital, for example, by allowing contact maintenance with larger and more diverse groups of acquaintances [Young, 2011]. Examining the relationships between Facebook use and the formation and maintenance of bridging, bonding and maintained social capital in a cross-sectional [Ellison et al., 2007] and longitudinal study [Steinfield, Ellison and Lampe, 2008], the authors found Facebook use to be a predictor of bridging social capital. Due to its inclusion of identity information in the users' profile pages, interests and mutual friends, it may be feasible to use Facebook to connect users with shared interests and encourage the conversion of latent ties into weak ties, which in turn increases bridging social capital [Ellison et al., 2011]. Exploring the relationship between different Facebook elements, such as wall posts, status updates and direct messaging, Yoder and Stutzman [2011] suggested the intensity of Facebook use to be positively associated with perceived bridging social capital and wall posts to be a predictor of perceived bridging social capital. Moreover, perceived bridging social capital appears to be related to the number of Facebook friends [Brandtzæg and Nov, 2010].

Facebook use appears to have a limited impact on the creation and maintenance of bonding social capital [Ellison et al., 2007; Steinfield et al., 2008; Burke, Marlow and Lento, 2011]. Yet the social network site is regarded as useful, in that it provides another way for the interaction with strong ties, especially when face-to-face interaction is not feasible, due to close friends and family being geographically dispersed [Vitak et al., 2011]. Examining the relationship between different kinds of online social network activities and social well-being, Burke, Marlow and Lento [2010] found that one-on-one communication in Facebook is associated with increased perceived bonding social capital and lower loneliness.

Several studies suggest that Facebook may be particularly beneficial for users who are "network disadvantaged" or have a low self-esteem or low satisfaction, as it appears to lower barriers of interaction that under-confident people or people with lower communication skills might experience in offline situations [Ellison et al., 2007; Steinfield et al., 2008; Burke et al., 2011]. The term *network disadvantaged* generally refers to members of social networks poorer than others in social resources [Rostila, 2010a]. Applied to different contexts, it may refer to disadvantaged neighborhoods with lack of contact to individuals representing mainstream society, including members of low socioeconomic groups [Haines, Beggs and Hurlbert, 2011; Rostila, 2010a].

In an organizational context, Steinfield, DiMicco, Ellison and Lampe [2009] found that the use of an internal social network site provided greater social capital benefits for employees in otherwise "network disadvantaged" positions, especially newer and younger employees and those employees in a hierarchically lower position. In this study, networks of individuals consuming unhealthy food or not engaging in physical activity are considered to be disadvantaged networks.

Social network sites may be a viable source of especially bridging social capital for people who are otherwise "network disadvantaged."

Ellison et al. [2010] suggest five mechanisms of social capital generation on Facebook:

1. Maintenance of a larger and more diverse set of weak ties
2. Making ephemeral ties persistent
3. Lower costs of maintaining (or re-engaging) weak ties
4. Lower barriers of initial interaction and facilitation of formation of common ground due to inclusion of profile information
5. Easier information and support seeking, easier provision of resources to others

This research considers social capital as an inherent property of social networks and employs social network concepts and methodology to measure individual social capital [Borgatti, Jones and Everett, 1998; Lakon, Godette and Hipp, 2008; Lin, Cook and Burt, 2001; Moore, Shiell, Hawe and Haines, 2005]. Social capital measures may be based on social network structure, presence of specific alters, volume, diversity and social resources, for instance.

Health-related Outcomes of Social Capital

More recent literature reviews highlight the association between social capital and health [Kim, Subramanian and Kawachi, 2008; Almedom and Glandon, 2008; Lindström, 2008].

In addition, social capital has been identified as one determinant of population health [Hyyppä, 2010], since it enables a comprehensive understanding of the link between social relationships and health [Rostila, 2008]. Further, as access to information and affective support leads to a greater sense of belonging, social capital is positively associated with individual health outcomes [Moore, 2010]. In fact, Moore [2010] goes so far as to highlight that individual access to social capital is not limited to people who are geographically close and that some people may have better access than others to socially valued resources.

Lin [2001a] suggests that individuals have unequal access to the resources embedded in a social network. Depending on their structural and positional embeddedness, individuals are enabled or disabled to mobilize social capital for purposive actions. The mobilized social capital determines the returns and may impact an individual's physical health and mental health, as shown in Figure 3.

To understand the relationship between social capital in online social networks and health outcomes, this research considers the structural and positional embeddedness of individuals in online social networks and examines the quality and quantity of accessible resources and how individuals use these resources.

Drawing on Portes' work [1998] on the potential downside of social capital, Rostila [2011] argues that having a high degree of closure and density might limit an individual's access to socially valued resources. These networks have few bridging links to outside social structures and show a high degree of interconnectedness among their members.

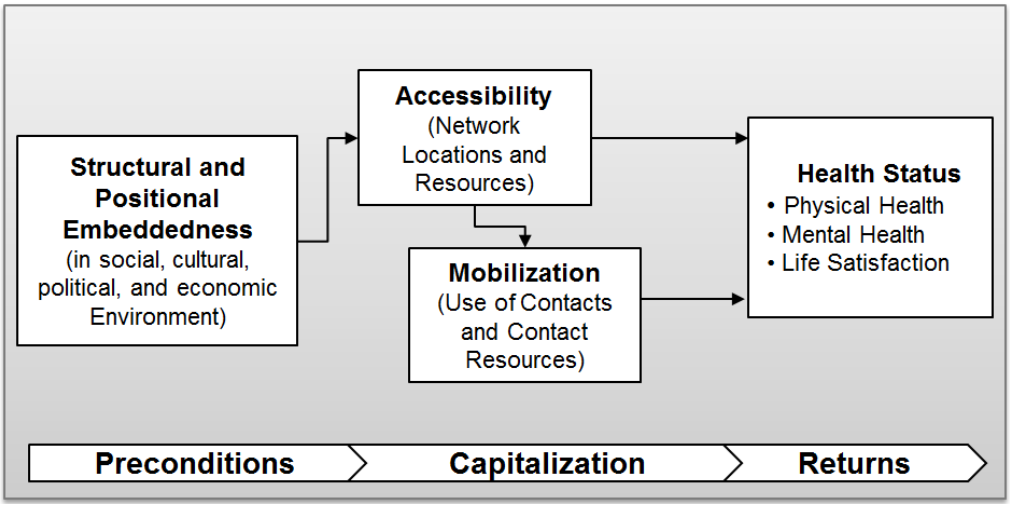

Figure 3. Modeling a Theory of Social Capital (Adapted from Lin, 2001a)

Investigating a network of migrants in Sweden, Rostila [2010a] shows how closed network structures contribute to the exchange of "bad social capital" by producing and maintaining negative norms and behaviors. Stating that a closed network may be at a greater risk of producing negative health externalities, Rostila's point of view is contrary to Coleman's theory of functional social capital [Coleman, 1988, 1994], which accentuates the need for closed network structures and social trust to achieve beneficial health outcomes and well-being.

The Internet connects individuals with similar interests via online communities. Providing social support [Hwang, Ottenbacher, Green, Cannon-Diehl, Richardson, Bemstam and Thomas, 2010] and informational support, online health communities allow people to seek information, communicate with others with the same or similar diseases, share health guidance and compare treatment and medication strategies. The accessibility from everywhere at anytime, the anonymity of the medium, as well as the access to greater expertise, are regarded as the main benefits of online health communities [Maloney-Krichmar and Preece, 2002]. Having studied an online health community for two and a half years, Maloney-Krichmar and Preece [2005] state that this community provided access to bonding social capital (e.g., in the form of emotional support), as well as bridging social capital by linking members to diverse sets of resources.

Description and Discussion of Existing Social Capital Frameworks

Hyyppä [2010] describes and critically evaluates social capital frameworks created by global organizations, such as the World Bank, the WHO, the Offices for National Statistics of the UK, New Zealand and Australia. Since Hyyppä [2010] explicitly recommends the framework of the Policy Research Initiative (PRI) for studying relations among social networks, social capital and health, the social capital framework of the PRI [2005] will be described and discussed in the following section.

Social Capital Framework of the Policy Research Initiative in Canada

The Policy Research Initiative (PRI) wanted to look at how social networks, positions of members within these networks and their interactions shape the nature and circulation of social resources within the network. Considering social networks as the central element of social capital, the PRI constructed their framework based on the operational definition of social capital as "social networks that may provide access to resources and social support" [PRI, 2005, p. 7]. Figure 4 presents the framework of the PRI. It distinguishes social capital (social networks) from its sources (determinants) on the individual level or group level. The generated social capital leads to different kinds of resources and support shaping social, economic, as well as health, outcomes. The framework uses indicators and measurement tools drawn from the field of social network analysis that differentiate between the structure of networks (characteristics of networks, members and relationships) and their dynamics (conditions for creation and mobilization). The PRI framework suggests that social capital—and thus the resources—operate among people with complementary resources (e.g., financial capital) in a specific situation or context.

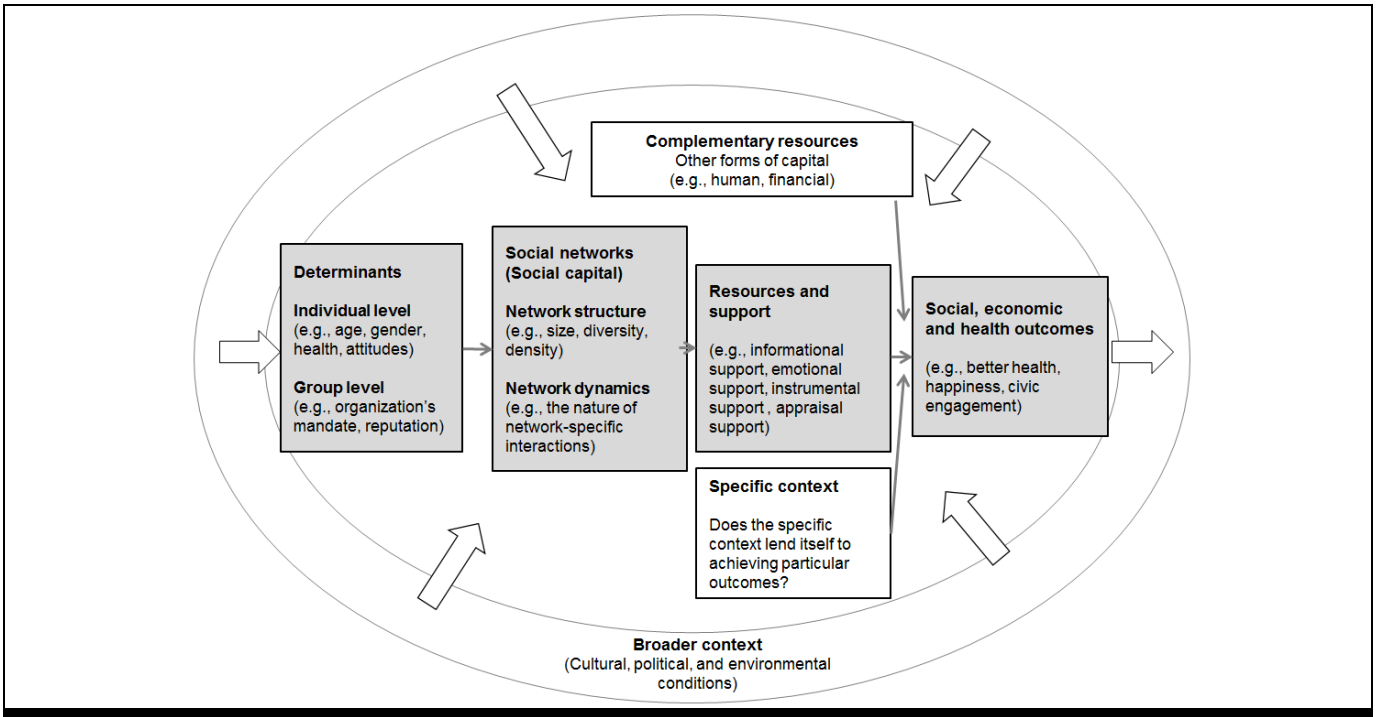

Figure 4. Social Capital Framework of the PRI (Adapted from PRI, 2005, p. 9)

The recommended indicators of network properties, member characteristics and relational properties, as well as corresponding hypotheses are listed in Table 1 [PRI, 2005].

Table 1: Measuring Social Capital Through Network Structure

	Indicators	Description	Hypotheses
Network structure	Network size	Number of people with whom individuals maintain different types of relationships (friends, family, acquaintances, neighbors, colleagues, etc.)	• Larger networks are associated with a higher probability for availability and accessibility of a particular resource. • Smaller networks are related to less access to resources.
	Network density	Degree of interconnections among the members of a network	• The higher the interconnectedness, the more the network is closed (exclusive) and the more homogeneous the resources within the network.
	Network diversity	Heterogeneity of the socioeconomic status of the members	• Strong social homogeneity creates bonding relations providing access to important resources and allowing individuals to get by. • Weak social homogeneity creates bridging relations providing access to new and diverse resources and allowing individuals to get ahead.
Network dynamics	Relational frequency	Number and duration of contacts among the members of a network	• Relational frequency and the number of contacts of individuals help to assess their level of "sociability."
	Relational intensity	Strength and nature of a relationship in terms of emotional investment	• Strong ties will lead to exchange of resources requiring a significant emotional, financial, or time investment. • Weak ties or bridging ties provide access to varied and nonredundant resources.
	Spatial proximity	Number of contacts with whom individuals maintain face-to-face relationships on a regular basis	• Ties occurring at geographic proximity significantly contribute to social capital.

For the construction of the conceptual model in this article, the PRI's framework is valuable in that it allows the analysis of how resources are distributed, the availability of specific types of resources and how social networks contribute to health outcomes. Illustrating relationships between important variables in the context of social networks, social capital and health, as well as providing hypotheses and recommendations for indicators, the framework of the PRI forms the basis of the conceptual model developed in this article. Yet this study does not equate social capital with social networks.

Framework for Measuring Social Capital in Online Communities

Seeking to explore social capital within online communities, Smith, Giraud-Carrier and Purser [2009] developed a framework that has been applied to quantitatively determine social capital, among others in the blogosphere [Smith, Giraud-Carrier and Purser, 2008] and on Twitter [Smith and Giraud-Carrier, 2010].

According to Smith [2008], social capital in a community is based on relationships, individuals' attributes and the available social resources. Due to the specific characteristics of ties within social media, Smith [2008] makes a distinction between two types of connections:

1. Explicit connections are well-defined ties between individuals; for example, "is a friend of." Individuals are aware of those explicit ties among themselves.
2. Implicit connections link individuals together based on affinities or similarities, such as shared interests, attitudes, or hobbies. Individuals are not necessarily aware of the similarities existing among themselves. Implicit edges are calculated using measures of similarity between nodes.

Based on these two types of connections, explicit social networks and implicit affinity networks are introduced as the main framework components. Explicit social networks and implicit affinity networks are regarded as complementary.

Figure 5 visualizes the combination of the two different network types within a so-called hybrid network.

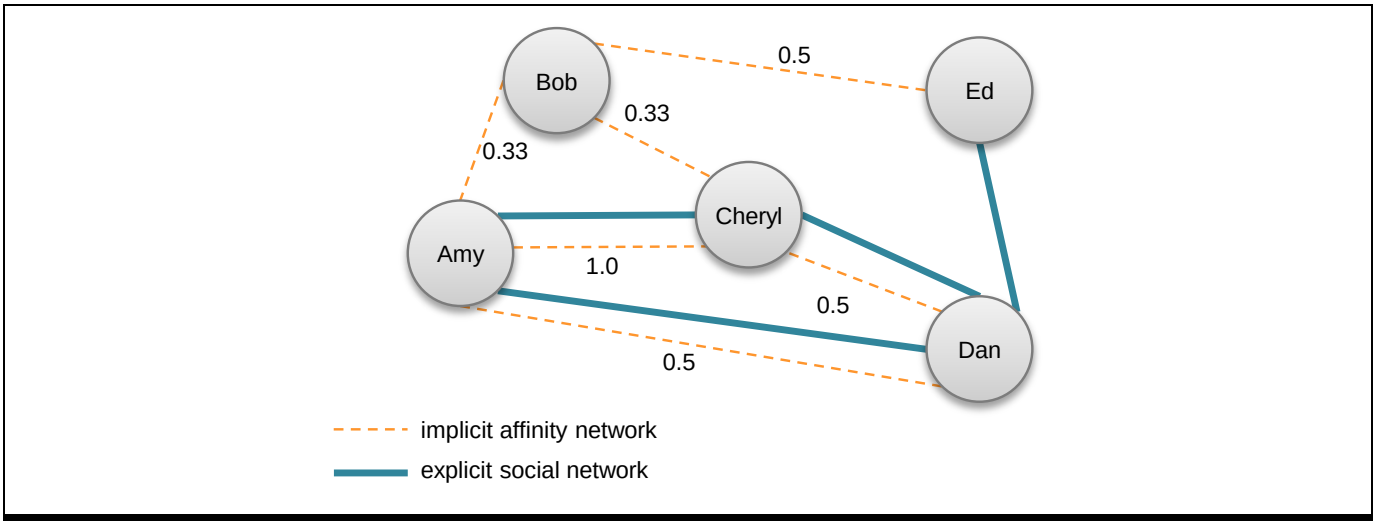

Figure 5. Hybrid Network—Explicit Social Network and Implicit Affinity Network Combined (Adapted from Smith, Giraud-Carrier and Purser, 2009)

The dotted lines in Figure 5 show the implicit affinity network. Ranging between [0,1], the numbers indicate the degree of similarity between two people. The solid lines depict the explicit social network. For example, Amy and Cheryl are explicitly connected and show a maximum degree of similarity (1.0). In contrast, Cheryl and Bob are neither friends nor very similar to each other (0.33).

Implicit connections are perceived as important in social capital, yet social capital can be accessed and mobilized only when individuals are aware of it and create explicit connections between them [Smith, Giraud-Carrier and Purser, 2008].

Potential bonding or potential bridging social capital occurs when there are no explicit links between two people who show some degree of similarity. Realized bonding or realized bridging social capital occurs only in explicit social networks when declared connections are present among individuals. Regarding bonding and bridging social capital as complementary rather than exclusive, Smith [2009] suggests that many groups in networks serve both functions. Yet networks as a whole could be classified as being bonding or bridging.

The framework of Smith and Giraud-Carrier [2010] is valuable in that it includes latent ties [Haythornthwaite, 2002] as implicit connections and distinguishes between potential and realized social capital. Implicit connections, for example, friends of friends with similar attributes, are widely present in social media, such as social network sites and may, just as explicit connections, influence individuals via a mutual friend. The discovery of implicit links may be more likely on a social network site like Facebook, as individuals can easily obtain information on friends of friends or passively consume comments from friends of friends in their newsfeed. Due to implicit links being somewhat more accessible and closer to individuals than in the real world, they may also influence their health-related behaviors and body weight.

Yet, Smith and Giraud-Carrier's [2010] understanding of bonding social capital should be regarded critically. In the framework, bonding and bridging social capital are based on the similarity and dissimilarity strength of individuals. Yet, as discussed above, bonding social capital incorporates many other aspects, such as strong ties and closeness between people [Putnam et al., 1994], which may not be reflected by a measure of similarity only.

Thus, the conceptual model introduced in the next section will go beyond a quantitative measure of similarity and include other indicators of bonding social capital, such as the previously mentioned indicators of intimacy and closeness to determine tie strength, too.

IV. KEY CONSIDERATIONS FOR THE DEVELOPMENT OF THE CONCEPTUAL MODEL

In order to develop our conceptual model, we looked closely at the key considerations emerging from the literature. The objective of this article is to develop and describe a conceptual model that draws a relation between the *structure and content* of an individual's *online social network*, the resulting *opportunities and limitations to accessing resources* and his or her *health-related behaviors* and *body weight*. Due to this study's focus on online social connections, the conceptual model should reflect the specific characteristics of online social networks and enable the determination of individuals' social capital through the analysis of personal network data. Moreover, the model

should acknowledge the necessity of a mixed methods approach applying both quantitative methods to determine social capital through the network structure and qualitative methods to examine the content of social relations more deeply [Kneidinger, 2010].

Based on the literature review, Table 2 provides an overview of content-related and methodological key considerations for the construction of the conceptual model and research design in this study. Contentwise, previous studies on the association between social capital and health overemphasized the positive impact of social capital and neglected the potential damaging effects [Kawachi, Subramanian and Kim, 2008]. For instance, bonding social capital may prohibit an effective health promotion in disadvantaged communities, as it possibly limits the access to bridging social capital outside their social milieu [Kim, Subramanian and Kawachi, 2008; Kawachi et al., 2008]. Thus, future studies should distinguish between the effects of bonding versus bridging capital [Kim et al., 2008] and examine the different implications of being well-connected in a disadvantaged network vs. being well- (or even loosely) connected in an advantaged network [Moore, 2010]. In online social networks, research should analyze how ideas and opinions diffused in online social networks influence individuals' offline social networks [Bollen, Goncalves, Ruan and Mao, 2011; Young, 2011].

Table 2: Addressed Gaps and Key Considerations for This Research

Content	Consideration of possibly negative effects of social capital [Kawachi et al., 2008]
	Distinction between the possibly different effects of bonding and bridging social capital [Kim et al., 2008]
	Different implications of being well-connected in a disadvantaged network vs. being well- or even loosely connected in an advantaged network [Moore, 2010]
	Impacts of different relationships on health-related behavior and body weight [Moore, 2010]
	Consideration of different aspects of online relationships that go beyond the concept of strong and weak ties [Ellison et al., 2011]
	Evaluation of the quality of social capital built online to understand how individuals support each other [Young, 2011]
	Influence of opinions and ideas within online social networks on an individual's behavior in "real life" [Bollen et al., 2011; Young, 2011]
Method	Need for longitudinal data [Kim et al., 2008; Hyyppä, 2010; Moore, 2010]
	Applications of network-based measures is recommended [Kawachi et al., 2008]
	Use of tools not based on surveys and self-reported data [Ellison et al., 2011; Vitak et al., 2011]
	Consideration of more diverse populations [Ellison et al., 2010; Steinfield et al., 2008; Burke et al., 2010]
	Refinement of measures for online ties is needed [Ellison et al., 2011]
	Need for longitudinal studies [Steinfield et al., 2009; Burke et al., 2010; Ellison et al., 2011; Vitak et al., 2011]

With regard to the methodology, the lack of longitudinal data has been identified as a major issue. The cross-sectional nature of most studies makes it difficult to establish causality, in that it cannot be determined whether social capital is a consequence of good health or vice versa [Kim et al., 2008; Hyyppä, 2010; Moore, 2010]. Moreover, the application of the network theory of social capital and, thus, network-based measures may prove more accurate in assessing a person's resource accessibility and measuring the positive and negative effects of social capital on health [Lakon et al., 2008; Moore, Daniel, Paquet, Dubé and Gauvin, 2009b; Bourdieu, 1986; Lin, 2001b]. Online tools applying network-based measures could minimize the noise of self-reported data produced through the use of questionnaires in previous studies [Ellison et al., 2011; Vitak et al., 2011]. Moreover, future studies in online social networks should look at more diverse populations and tools to measure social capital and communication practices should be refined, for example, by analyzing postings on the site, as well as server-level data [Ellison et al., 2010].

Establishing the theoretical groundwork for this research, this article concentrates on content-related considerations. The proposed conceptual model is intended to explain the influence of online social networks on an individual's health-related behaviors and bodyweight. Findings on this relationship will inform the development of possible online intervention strategies.

V. PROPOSED CONCEPTUAL MODEL

Integrating the previously presented information, the proposed conceptual model (Figure 6) shows how different variables may influence people's health-related behaviors and body weight.

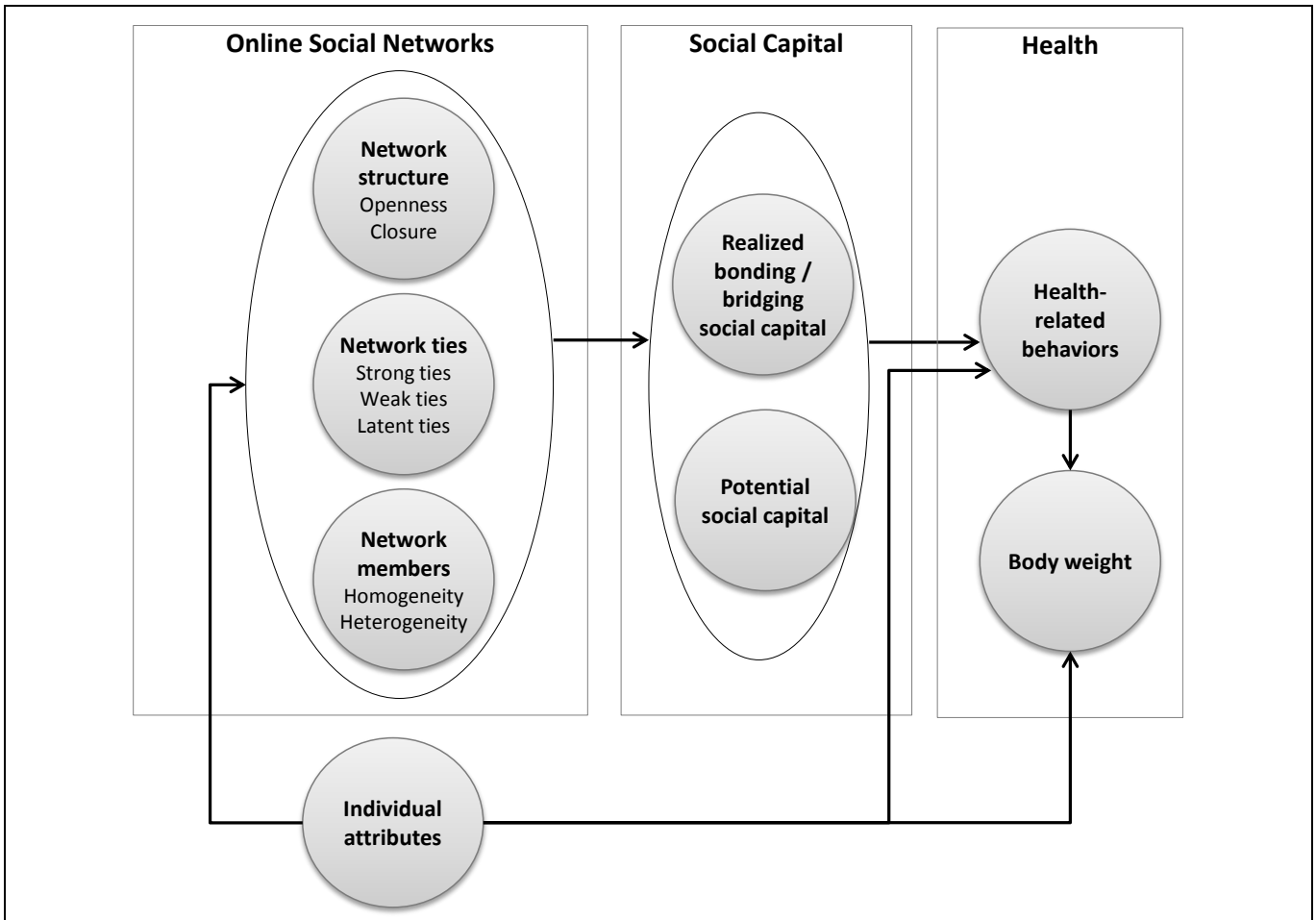

Figure 6. Proposed Conceptual Model

Including three network constructs—*network structure*, *network ties and network members*—the proposed conceptual model enables the analysis of both network locations and resources embedded in the network [Lin, 2001a]. The former is covered by measures determining the degree of *network openness/closure* and the relative importance of *strong and weak ties*. The embedded resources may be determined using the degree of *network homogeneity/heterogeneity* which allows the analysis of the range, variety and composition of resources accessible to an individual. Additionally, *latent ties,* which are technically possible online social connections but not yet activated [Haythornthwaite, 2002], are recognized as a specific feature of online social networks which may, just as explicit strong or weak ties, influence the nature of the embedded resources.

The conceptual model is based on Lin's notion of social capital: *Social capital* refers to resources embedded in social networks maintained by individuals which can be accessed or mobilized through ties in the network and generate returns [Lin, 2001a]. It incorporates elements from both of the social capital frameworks discussed in the previous section. Similar to the social capital framework of the PRI [2005], the conceptual model developed in this article distinguishes between the sources (determinants) and effects of social capital and uses indicators and measurement tools drawn from the field of social network analysis. Contrary to the social capital notion of the PRI, in this study, social capital is not equated with social networks, but social networks are considered to be a precondition of social capital and place where social capital emerges [Rostila, 2011]. Like the framework of Smith, Giraud-Carrier and Purser [2009] for measuring social capital in online communities, the conceptual model differentiates between *realized social capital* and *potential social capital*. Besides explicit connections, users of online social networks may have implicit access to a broad range of latent ties forming their potential social capital which may—in addition to realized social capital—shape their attitudes and exert influence on their health-related behaviors and thus the individual health outcome. Contrary to Smith's work, this study suggests that bonding or bridging social capital can be determined only by analyzing interactions happening along explicitly declared ties in online social networks.

Therefore, the conceptual model differentiates between realized bonding and bridging social capital but does not include this distinction for potential social capital.

Health-related behaviors and body weight are recognized as the returns or effects of different social capital types. The conceptual model's dependent variable is the *body weight* of the observed individual. The variance of the body weight is attempted to be explained by the independent variables. These include *individual attributes, network structure, network ties, network members, realized bonding/bridging social capital, potential social capital and the individual's health-related behaviors*.

The variables can be grouped in the three categories of *online social networks*, *social capital and health* as presented in Table 3.

Table 3: Categories of Variables

Category	Variables
Online social networks	• Network structure • Network ties • Network members • Individual attributes
Social capital	• Realized bonding social capital • Realized bridging social capital • Potential social capital
Health	• Health-related behaviors • Body weight

Organized according to the categorization in Table 3, the subsequent sections discuss the relationships among the independent variables and establish how they are related to the dependent variable. Moreover, the article's main research question, "*How do the properties and thus available resources in an individual's online social network influence his or her health-related behaviors and body weight?*," is divided into six sub-questions. These questions are presented for the different parts of the conceptual model.

Online Social Networks

Network Structure

The construct *network structure* includes measurement items such as network size, density, cliques, brokerage and constraint [ABS, 2004; Berkman et al., 2000; Burt, 2001; PRI, 2005; Borgatti et al., 1998].

Using methods from the field of social network analysis, these structural properties are calculated mainly to determine the degree of network openness/closure. The network structure may be connected with the explicit and implicit ties and the network homogeneity/heterogeneity, too. For instance, high network density may be a predictor of a rather closed and homogeneous network with strong ties among members [Berkman et al., 2000; PRI, 2005].

The network openness/closure is hypothesized to interact with the other three online social network characteristics. As discussed before, closed networks may overlap with strong ties and a higher degree of network homogeneity, whereas, in open networks, the level of interconnections among members is suggested to be lower and the exchanged resources more diverse [PRI, 2005]. The online social network of an individual who has ties to a bounded community only; for example, family and friends of their hometown, may be very dense, as a high proportion of these people will know each other. They may also have similar backgrounds, as they attended the same school, were members of the same associations, etc. [ABS, 2004]. Contrary, the online social networks of a person who has lived in different places or has many different interests, which is likely to be more open, have a higher number of weak ties and people from different backgrounds.

> *RQ1. How is the degree of network openness/closure related to an individual's health-related behaviors and body weight?*

Findings from the literature suggest that closed networks, particularly when interacting with a high degree of network homogeneity, are more likely than open networks to produce and maintain negative norms and behaviors leading to negative health outcomes [Rostila, 2011]. In this study, networks of individuals consuming unhealthy food or not engaging in physical activity are considered to be disadvantaged networks. An elevated body weight and, thus, a person being overweight or obese, is recognized as a negative health outcome.

Network Ties

Due to ties in online social networks being indistinguishable with respect to their strength [Lewis, Kaufman, Gonzalez, Wimmer and Christakis, 2008], it is important to identify meaningful relations. To be considered as meaningful, there should be some kind of activity, among others the exchange of wall posts or comments, happening along the ties [Wilson, Boe, Sala, Puttaswamy and Zhao, 2009]. These could be classified as strong or weak ties in a next step. Passive ties which are explicitly declared, but not really used, may automatically be considered to be weak ties. Allowing for passive consumption, they are suggested to have an indirect influence on individuals.

Strong and weak ties are determined by considering the online social network's relational properties. The construct, *network ties,* examines the network's composition, tie multiplexity, duration of a contact and communication mode, as well as the intimacy and intensity of a contact [Berkman et al., 2000; ABS, 2004; PRI, 2005]. Looking at the network composition enables the identification of family members, friends, or colleagues in an individual's online social network and provides information on the context and role in which persons have become acquainted. It is also connected to the determination of multiplex ties, which are based on knowing a person in more than one relationship context, for instance, colleagues who are good friends at the same time. Multiplexity is an indicator of tie strength [Granovetter, 1973], yet the intimacy, intensity and duration of a contact are the best variables to predict tie strength in online social networks [Gilbert and Karahalios, 2009].

According to Kaplan and Haenlein [2010], the intimacy and immediacy of a communication mode influence the degree of social presence that can be achieved between two communication partners. Interpersonal and synchronous forms of communication are suggested to induce a higher degree of social presence than are mediated and asynchronous communications [Kaplan and Haenlein, 2010]. Even though all communications within online social networks are mediated to some extent, directed communication, like the exchange of personal messages, may be considered as more interpersonal than undirected messages such as status updates [Burke et al., 2011]. Synchronous forms of communication, for example, live chat, are featured in social network sites such as Facebook. Being linked to a higher social presence, they may exert more social influence [Kaplan and Haenlein, 2010].

Measuring variables related to network ties requires a mixed methods approach. (Qualitative) ethnographic research methods can be used to explore the content of social relations in online social networks [Hine, 2008], while quantitative procedures, such as text mining, may be feasible to determine the attitudes of individuals or to detect intimacy words [Bodendorf and Kaiser, 2009; Gilbert and Karahalios, 2009].

Implicit (latent) ties could refer to all possible online social connections of an individual. Theoretically, connections between all Facebook members are technically feasible but not necessarily declared. However, in this research, *latent ties* will refer only to online social connections of friends of the observed individual. Thus, besides personal network data of the individual, the analysis of the online social networks of friends would be required as well. Here, the consideration of the friends' strong ties is recommended, as the observed individual may be likely to be confronted with, for example, wall posts exchanged between a friend and his or her close friends. Also, the individual may be likely to meet these close friends of a friend at some point in real life, which could lead to the conversion of this latent tie into a weak tie in the online social network.

Similar to the degree of network openness/closure, the network characteristics of strong/weak ties and latent ties are suggested to interact with the other online social network characteristics. For instance, strong ties could interact with network homogeneity, in that the observed individual has strong ties to members who are similar to him or her [Lakon et al., 2008].

RQ2. How are strong and weak ties related to an individual's health-related behaviors and body weight?

With regard to the relationships among social capital, mastery and education, Moore, Daniel, Gauvin and Dubé [2009a] found that lower-educated individuals relied more on family and friends for access to social resources and had less weak ties than higher-educated individuals. Transferred to the context of this study, it could be hypothesized that individuals with an elevated body weight are more dependent on their strong ties and have less contact with their weak ties than normal-weight individuals.

Network Members

The construct *network members* considers the same measurement items as the construct *individual attributes* described in the next section. For each member of the observed individual's online social network, socio-demographic variables, such as age, gender and profession, as well as his or her interests and activities, need to be identified. The degree of similarity among the network members with respect to different attributes determines the network's homogeneity/heterogeneity [ABS, 2004; PRI, 2005].

In combination with the previously discussed strong and weak ties, it will be interesting to see whether individuals communicate most frequently with people from similar backgrounds. Also, it can be determined whether a person's strong ties are concentrated in particular groups consisting of diverse people sharing a common interest, for example, a sports club or choir, or rather exist between family members who tend to be more homogeneous [ABS, 2004].

> *RQ3. How is the degree of network homogeneity/heterogeneity related to an individual's health-related behaviors and body weight?*

Moore et al. [2009b] found that individuals with diverse social networks had a lower risk of overweight and obesity. It could be hypothesized that the networks of individuals in different body weight ranges exhibit different degrees of network homogeneity. Also, in disadvantaged networks, a higher degree of network homogeneity may increase the risk of unhealthy behaviors and an elevated body weight.

Individual Attributes

Similar to the construct *network members,* the construct *individual attributes* includes socio-demographic measurement items [PRI, 2005], such as a person's age, gender and profession, as well as his or her interests, activities and intensity of Facebook usage.

Individual attributes are suggested to influence the online social network characteristics, health-related behaviors and the individual health outcome.

Findings from previous studies suggest that a person's online social network is mainly based on offline connections and mirrors the wider offline social network of a person [Boyd and Ellison, 2007]. Thus, people who have got to know many people due to having a number of different interests and activities or lived in different places may have a larger and less dense online social network allowing them to maintain many weak ties. Online social network characteristics may also be influenced by a person's age, gender and social network site usage. A major part of U.S. Facebook users, for instance, are between eighteen and thirty-four years [Smith, 2010]. The number of Facebook friends and Facebook activity can be assumed to be related to age, too. Teenagers and people in their Twenties tend to have most friends and to be the most active group on Facebook [Zarrella, 2010].

Individual attributes are considered to be a predictor of a person's health-related behaviors and body weight. Despite people's social environment being recognized as a major determinant of their health-related behaviors, their engagement in physical activity and eating habits are also shaped by individual preferences that are not necessarily dependent on their social networks. For instance, some people may enjoy sports even if their family and close friends are not sporty at all.

Regarding the relationship between individual attributes and a person's body weight, socio-demographic variables, such as a person's age and gender, are suggested to influence a person's body weight. Therefore, a relationship between individual attributes and a person's body weight needs to be examined.

Social Capital

The four online social network characteristics are related to either *realized bonding/bridging social capital* or *potential social capital.*

Realized Bonding or Bridging Social Capital

Bonding social capital occurs in homogeneous groups of people sharing similar interests or characteristics whereas *bridging social capital* is associated with networks with weak ties between heterogeneous people. Classifying bonding or bridging social capital in an individual's online social network can be done using the previously described online social network characteristics. A high degree of network closure, high reliance of the individual on strong tie contacts and high degree of network homogeneity are suggested to predict bonding social capital [Rostila, 2011]. On the contrary, open networks increase bridging social capital by allowing individuals to establish new links which may provide access to more diverse resources [PRI, 2005].

Potential Social Capital

Potential social capital is suggested to result from the *latent ties*—that is, the strong tie contacts of explicit online connections—in an individual's online social network. The observed individual may passively consume information produced by these latent ties, for example, by following wall posts between friends of friends, photo comments, etc. In relation to *explicit bonding or bridging social capital*, potential social capital is suggested to be less influential. Yet, due to its higher accessibility in online social networks, it should be examined in more detail.

Health

Health-related Behavior

The construct *health-related behaviors* examines individuals' diet and their engagement in physical activity. People's dietary behavior may be determined by considering their servings of fruit and vegetables per week. Physical activity is assessed by instances of different kinds of sports per week [Moore et al., 2009b].

Individual behaviors, lifestyle choices and preferences are subject to social influences. People's social environment may enable or constrain the adoption of health-promoting behaviors [McNeill et al., 2006], as indicated by the arrows between *realized bonding/bridging* or *potential social capital* and *health-related behaviors*.

Findings from the literature suggest that bonding social capital may be associated with detrimental health effects, especially when individuals maintain bonding relations in disadvantaged, homogeneous and closed communities [Rostila, 2010a]. Thus, it could be theorized that people using social network sites to primarily interact with strong tie contacts may be more likely to practice unhealthy behaviors, especially when their strong tie contacts have an unhealthy lifestyle. Contrary, the possibly more diverse online social networks of active people who are members of sports clubs or other societies may provide access to more bridging social capital [ABS, 2004]. *Potential social capital* could influence an individual's health-related behaviors, too. Following people regularly exchanging information on sports activities may spark an individual's interest in a sport or motivate him or her to engage in sports more often.

RQ4. How does bonding social capital influence an individual's health-related behaviors and body weight?

Being based on rather closed and homogeneous networks with strong ties [Rostila, 2011], bonding social capital reflects the co-occurrence of three out of four online social network characteristics. It also includes the principle of homophily which refers to the tendency of people to interact and have the closest ties with people who are similar to them [Lakon et al., 2008]. It is possible that individuals with an elevated body weight feel more comfortable when interacting with their family and close friends as they might experience a lower self-esteem due to their weight issues.

Findings from the literature suggest that bonding social capital may be associated with detrimental health effects, especially when individuals maintain bonding relations in disadvantaged, homogeneous and closed communities [Rostila, 2010a].

Yet, it can be hypothesized that the quality of bonding or bridging social capital matters. Frequent interaction with strong tie contacts does not necessarily have a bad influence on a person's eating habits if these contacts set a positive example. For instance, frequent interactions within families practicing healthy behaviors should not have negative effects on an individual's behavior. Rather, a downward leveling of social norms is suggested to occur in *disadvantaged communities* [Kawachi et al., 2008; Rostila, 2010a; Moore, 2010], which could—in this study—be translated into *communities practicing unhealthy behaviors*.

RQ5. How does bridging social capital influence an individual's health-related behaviors and body weight?

Literature suggests that bridging social capital occurring in heterogeneous networks with open circles and weak ties provides access to diverse sets of resources and may be an important force in health promotion [Kawachi et al., 2008]. Greater access to a variety of resources is associated with a lower risk of overweight and obesity [Moore et al., 2009b]. Being considered as especially useful for the formation and maintenance of bridging social capital [Young, 2011; Ellison, Steinfield and Lampe, 2007; Steinfield et al., 2008; Ellison et al., 2011; Yoder and Stutzman, 2011; Brandtzæg and Nov, 2010], social network site activities may be beneficial to promote positive behaviors. In particular, this may be the case if individuals are confronted with bridging social connections acting as role models by posting about their sports activities, for instance.

RQ6. How are latent ties and potential social capital related to an individual's health-related behaviors and body weight?

Due to online social networks being feasible to connect users with shared interests, latent ties may be considered as a pre-stage of explicit weak and—possibly future—strong ties [Ellison et al., 2011]. Resulting from latent ties, potential social capital may be regarded as a predictor of bridging social capital. Content provided by implicit connections can be consumed passively by the observed individual and may give them access to more diverse sets of resources. The association between indirect ties or potential social capital and health-outcomes has not been explored before.

Bodyweight

The construct *body weight* is the dependent variable in this study. Besides *individual attributes*, such as gender and age, that may influence an individual's body weight, the conceptual model points to associations between the online social network characteristics, as well as the health-related behaviors and body weight. A direct relationship between different types of social capital and the body weight is not suggested. According to the conceptual model, the described different forms of social capital may shape an individual's health-related behaviors, which, in turn, have an impact on a person's body weight. Yet, the relationships between specific online social network characteristics, for example, *network closure* or high degree of *network homogeneity* and a person's health-related behaviors and body weight should be examined separately. For instance, a closed network may be associated with an elevated body weight. According to previous research, a diverse network may reduce the risk of overweight individuals [Moore et al., 2009b]. With regard to *ties* within the online social network, higher social presence is associated with a larger social influence that the communicating persons may exert on each other's behavior [Kaplan and Haenlein, 2010]. The ideas of social presence theory may thus be helpful to identify key persons—specifically contacts with whom the individual communicates in a directed and synchronous way—in an online social network. These contacts may have a possibly high influence on the individual's health-related behaviors and body weight.

The energy imbalance between consumed and expended calories is identified as the fundamental cause of obesity by the WHO [2011a]. Thus, it is believed that people practicing healthy behaviors, for example, following a healthy diet or exercising regularly, have a normal body weight, whereas people consuming unhealthy foods without doing sports on a regular basis may have an elevated body weight.

VI. DISCUSSION AND CONCLUSIONS

The presented conceptual model is literature-based and founded on the "offline" concept of social capital. It links people's social capital, which equals the resources embedded in their social networks [Lin, 2001b], with their health-related behaviors and health status.

To the authors' best knowledge, this conceptual model is the first one to transfer the linkage between people's offline social networks and health to online social networks. Establishing profound theoretical groundwork for future research crossing the boundaries between information systems, health informatics and sociology, it uses network-based measures to determine individual social capital and integrates the constructs *latent ties* and *potential social capital* as specific characteristics of online social networks.

The contributions of this article need to be weighed up against its limitations. The underlying assumption in this article is that sociological concepts such as social capital, as well as findings from literature addressing the relationship between people's (offline) social environment and their health status, may also be applicable to online social networks.

Offering similar functionalities as unmediated spaces and displaying people's extended offline social network, online social networks exhibit a high similarity to offline social relationships and are primarily used to maintain and reinforce existing offline relationships [Arnaboldi et al., 2011; Boyd and Ellison, 2007]. Therefore, we propose that online social networks are an additional determinant of health-related behaviors and a person's body weight and are feasible for treatment and intervention. Using a Facebook application to collect user-related data, the validation of the conceptual model—which is the next and mandatory step—will show whether our assumption is true. Subsequently, the conceptual model will be tested, revisited and refined.

Provided that an association among people's online social networks, their health-related behaviors and weight status can be proved, future research could then explore the implicit influence of online social networks on people's behaviors in more detail.

On a generic level, future studies may look at the intersection—or boundary—between the "real world" and the virtual world. There is evidence that online social networks shape people's attitudes, beliefs and behaviors. Yet the relative importance of real world social networks and online social networks is not clear. Who does affect our behaviors? Is it the people we meet every day at work or are our—possibly distant—close friends, to whom we talk through Facebook, more important?

If online social networks are an additional determinant of people's health-related behaviors and weight status, it will be interesting to see whether latent ties influence a person's attitude and health-related behaviors at all or which explicitly declared online social connections motivate people to practice a healthier lifestyle. The identification of

opinion leaders within personal online social networks could be one approach feasible to address this question [Bodendorf and Kaiser, 2009].

Once more is known about the social forces operating within online social networks, a next step could involve the creation of network-driven strategies to promote and reinforce positive norms and health-related behaviors. There is evidence that weight management interventions should shift their focus to friends of friends and the wider social network of obese individuals [Bahr et al., 2009] and that strength of social influence in online social networks may be greater than in real-world social networks [Ma et al., 2010]. Thus, these studies may provide an interesting starting point for a "vaccination" of people against a "social infection" to stop the propagation of non-communicable diseases in (online) social networks [Gershenson, 2011; Ma et al., 2010].

For instance, a Web application could support people in setting goals and create positive social pressure. Features fostering friendly competition among friends and friends of friends, for example, by enabling the comparison of sports results, as well as a reward system, may be feasible to reinforce positive behaviors. Focusing on personal attributes of the individuals, further research may also explore whether activity in social network sites or the usage of a Facebook application are particularly beneficial for people experiencing low self-esteem due to having weight issues.

The issue of overweight and obesity will be the first one to be addressed within this research. Many economies have been struggling with a rising prevalence of a number of health and social issues. Once the conceptual model is validated, future research projects addressing other use cases such as depression, alcoholism [Rosenquist, Murabito, Fowler and Christakis, 2010; Christakis and Fowler, 2008], or gambling may benefit from the theories and methods developed in this article.

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the article on the Web, can gain direct access to these linked references. Readers are warned, however, that:

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